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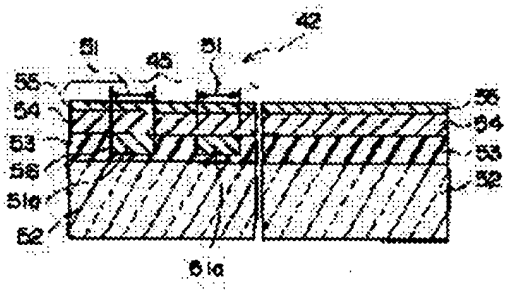
(54) MAGNETIC RECORDING MEDIUM AND ITS MANUFACTURE AND MAGNETIC RECORDING AND REPRODUCING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To improve position detecting accuracy by forming a linear or curved servo pattern traversing diagonally plural tracks in a physical shape on a magnetic recording medium.

SOLUTION: The magnetic disk 42 has a nonmagnetic substrate 52, a base layer 53 consisting of a nonmagnetic material on the substrate 52, a magnetic recording layer 54 consisting of a hard magnetic material on the base layer 53 and a protective layer covering over the magnetic recording layer 54. The base layer 53 existing in a servo area 45 is formed with grooves 56 where the servo pattern 51 is partially buried, and hard magnetic layer sections 51a are buried in these grooves 56. One servo pattern 51 is substantially composed of the hard magnetic layer 51a in one groove 56 and the magnetic recording layer 54 above this layer 51a. Then, since servo information is written in the hard magnetic layer sections 51a and the magnetic recording layer 54 above the grooves 56 in the servo area 45, no data other than the servo information is recorded in the magnetic recording layer 54 in the servo area 45.



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CLAIMS

[Claim(s)]
[Claim 1] The magnetic-recording medium characterized by having the magnetic-recording layer which is formed on a substrate and said substrate and is classified by two or more trucks, and the servo pattern for tracking of the shape of the shape of a straight line which crosses said two or more trucks aslant, and a curve.
[Claim 2] Said servo pattern for tracking is a magnetic-recording medium according to claim 1 characterized by carrying out two or more arrangement so that the phase of a truck signal may change with differences of the location of the truck cross direction in said truck.
[Claim 3] Said servo pattern for tracking is a magnetic-recording medium according to claim 1 or 2 characterized by being the pattern which appears by change of the thickness of the magnetic layer formed on said substrate.
[Claim 4] Said servo pattern for tracking is a magnetic-recording medium according to claim 1 or 2 characterized by said magnetic-recording layer being the pattern which it comes to divide partially.
[Claim 5] Said servo pattern for tracking is a magnetic-recording medium according to claim 1 or 2 characterized by being the pattern which appears by change of the irregularity partially formed in said magnetic-recording layer.
[Claim 6] The magnetic-recording layer which is formed on a nonmagnetic substrate and classified by two or more trucks, The magnetic-recording medium which has the servo pattern for tracking of the shape of the shape of a straight line which crosses these two or more trucks aslant, and a curve, The magnetic recording medium characterized by having the driving means which drives said magnetic-recording medium, the magnetic head arranged on said magnetic-recording medium, the base material which supports said magnetic head, and a migration means to move said base material.
[Claim 7] The process which forms in said resist the servo pattern latent image of the shape of the straight line which crosses aslant the process which applies a resist to the non-magnetic layer on a substrate or this substrate, and the field which arranges two or more trucks, or a curve by exposure, The process which forms opening in the perimeter of the part in which said resist was developed and said servo pattern latent image was formed, or said servo pattern latent image, The manufacture approach of the magnetic-recording medium characterized by having the process which etches said substrate or said non-magnetic layer through said opening, forms a slot, and forms the configuration of a servo pattern in said substrate or said non-magnetic layer by this.
[Claim 8] By the process which applies a resist to the magnetic layer front face on the substrate which has two or more truck fields, and exposure The process which forms in said resist the servo pattern latent image of the shape of the straight line which crosses said two or more truck fields aslant, or a curve, The process which forms opening which develops said resist and surrounds said pattern latent image, and by etching said magnetic layer through said opening, and forming a slot The manufacture approach of the magnetic-recording medium characterized by having the process which uses said magnetic layer surrounded by this slot as a servo pattern.
[Claim 9] Said exposure of said resist is the manufacture approach of the magnetic-recording medium according to claim 7 or 8 characterized by being carried out dividing into multiple times, and step-rotating or continuation rotating said substrate.
[Claim 10] Said exposure is the manufacture approach of the magnetic-recording medium according to claim 9 characterized by being made using an exposure mask at the time of a halt of said step rotation of said substrate.
[Claim 11] The alignment of said exposure mask is the manufacture approach of the magnetic-recording medium according to claim 10 characterized by being carried out for every time of a halt between said step rotations.
[Claim 12] Said exposure is the manufacture approach of the magnetic-recording medium according to claim 7 or 8 characterized by being carried out making a laser beam scan on said resist.
[Claim 13] The manufacture approach of the magnetic-recording medium characterized by having the process which forms the servo pattern of the shape of the straight line which crosses aslant the process which forms a magnetic layer on a substrate, and the field which etches said magnetic layer and is divided by two or more trucks by irradiating a laser beam, or a curve

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a magnetic-recording medium, its manufacture approach, and a magnetic recording medium.
[0002]
[Description of the Prior Art] In a magnetic disk drive, in order to increase magnetic recording density, it is in the inclination which makes track density of a magnetic disk high. In order to realize high track density, it is required to raise the tracking precision of the magnetic head. In order to detect the truck positional information, the phase servo system is adopted.
[0003] A phase servo system is a method which arranges a servo pattern so that the phase of a playback servo signal may change with the locations of the direction of a truck of the magnetic head (hoop direction). In the former, in order to record such a servo pattern on a magnetic-recording medium front face, the following approaches are adopted. For example, drawing 15 (a) The 1st pitch L1 of the magnitude which can be divided into plurality (three to about [for example,] 4) crosswise [of a truck 10] (the diameter direction) so that it may be shown The magnetic head 20 is shifted crosswise [of a truck 10], and it is the 2nd pitch L2 about the magnetic head 20. Two or more flux reversal patterns are formed in a magnetic-recording medium front face, shifting to a hoop direction, and the flux reversal pattern is used as a servo pattern 30. The magnetic pole width of face of the inductive head for record of the magnetic head 20 serves as the almost same magnitude as the width of recording track.
[0004] The detection precision of the tracking (truck positioning) information on a phase servo system becomes so high that the number of partitions of the diameter direction in each truck is increased, and, moreover, becomes so high that the servo pattern 30 is made into Sharp.

[0005]
[Problem(s) to be Solved by the Invention] However, when the number of partitions of each truck 10 is made to increase, the chart lasting time of the servo pattern 30 per magnetic-recording medium of one sheet will increase, and the positioning accuracy of the magnetic head 20 at the time of record of the servo pattern 30 will fall by truck of high density further. And drawing 15 (b) Since the bit deflection 31 arises at the edge of the servo pattern 30 by the leak field from the pole tip section of the magnetic head 20 or the erasion field 32 is generated at the servo pattern 30 edge by record blot so that it may be shown, there is a problem that the quality of servo information deteriorates.
[0006] This invention forms a servo pattern with high precision, and aims at offering the magnetic-recording medium which can improve location detection precision, its manufacture approach, and a magnetic recording medium.
[0007]
[Means for Solving the Problem]
(Means) The above-mentioned technical problem is solved by the magnetic-recording medium characterized by having the magnetic-recording layer 54 which is formed on a substrate 52 and said substrate 52, and is classified by two or more trucks 44, and the servo pattern 51 for tracking of the shape of the shape of a straight line which crosses said two or more trucks 44 aslant, and a curve so that it may illustrate to drawing 2 and drawing 3 .
[0008] In the above-mentioned magnetic-recording medium, said servo pattern 51 for tracking is characterized by carrying out two or more arrangement so that the phase of a truck signal may change with differences of the location of the truck cross direction in said truck 44. In the above-mentioned magnetic-recording medium, said servo pattern 51 for tracking is characterized by being the pattern which appears by change of the thickness of the magnetic layers 51a and 54 formed on said substrate 52.
[0009] In the above-mentioned magnetic-recording medium, said servo pattern 51 for tracking is characterized by being the pattern with which said magnetic-recording layer is partially divided, and becomes so that it may illustrate to drawing 13 . In the above-mentioned magnetic-recording medium, said servo pattern 51 for tracking is characterized by being the pattern which appears by change of the irregularity partially formed in the magnetic layer 71 which constitutes said magnetic-recording layer 55 so that it may illustrate to drawing 14 .
[0010] The magnetic-recording layer 54 which is formed on the nonmagnetic substrate 52 and classified by two or more trucks 44 so that the above-mentioned technical problem may be illustrated to drawing 1 and drawing 2 , The magnetic-recording medium 42 which has the servo pattern 51 for tracking of the shape of the shape of a straight line which crosses aslant these two or more truck fields 44, and a curve, It solves with the magnetic recording medium characterized by having the driving means 43 which drives said magnetic-recording medium 41, the magnetic head 46 arranged on said magnetic-recording medium 42, the base material 47 which supports said magnetic head 46, and migration means 48 and 49 to move said base material 47.
[0011] The process which applies a resist 58 to the non-magnetic layer 53 on a substrate 52 or this substrate 52 so that the above-mentioned technical problem may be illustrated to drawing 10 , drawing 12 , and drawing 14 , The process which forms in said resist 58 the servo pattern latent image of the shape of the straight line which crosses aslant the field which arranges two or more trucks, or a curve by exposure, The process which forms Openings 58a and 58b in the perimeter of the part in which said resist 58 was developed and said servo pattern latent image was formed, or said servo pattern latent image, Etch said substrate 52 or said non-magnetic layer 53 through said openings 58a, 58b, and 58d, and slots 56 and 68 are formed. It solves by the manufacture approach of the magnetic-recording

medium characterized by having the process which forms the configuration of the servo pattern 51 in said substrate 52 or said non-magnetic layer 53 by this.
[0012] The process which applies a resist 58 to magnetic layer 54 front face on a substrate 52 so that the above-mentioned technical problem may be illustrated to drawing 13 , The process which forms in said resist the servo pattern latent image of the shape of the straight line which crosses two or more trucks aslant, or a curve by exposure, The process which forms opening 58c which develops said resist 58 and surrounds said servo pattern latent image, and by etching said magnetic layer 54 through said opening 58c, and forming slot 54a It solves by the manufacture approach of the magnetic-recording medium characterized by having the process which uses said magnetic layer 54 surrounded by this slot 54a as a servo pattern 51.
[0013] In the manufacture approach of the above-mentioned magnetic-recording medium, said exposure of said resist 58 is characterized by being carried out dividing into multiple times, and step-rotating or continuation rotating said substrate 52 so that it may illustrate to drawing 8 R> 8. In the manufacture approach of the above-mentioned magnetic-recording medium, said exposure of said resist 58 is characterized by being made using the exposure mask 61 at the time of a halt of said step rotation of said substrate 52.
[0014] In the manufacture approach of the above-mentioned magnetic-recording medium, alignment of said exposure mask is characterized by being carried out for every time of a halt of said step rotation. In the manufacture approach of the above-mentioned magnetic-recording medium, said exposure is characterized by being carried out making a laser beam scan on said resist 58 so that it may illustrate to drawing 9 .
[0015] The process which forms a magnetic layer 54 on a substrate 52 so that it may illustrate to drawing 9 and drawing 13 , and by irradiating a laser beam, the above-mentioned technical problem etches said magnetic layer 54, and solves it by the manufacture approach of the magnetic-recording medium characterized by having the process which forms the servo pattern 51 of the shape of the straight line which crosses aslant the field divided by two or more trucks 44, or a curve.
[0016] (Operation) Next, an operation of this invention is explained. Since the servo pattern of the shape of the shape of a straight line which crosses two or more trucks aslant, and a curve was formed in the magnetic-recording medium in the physical configuration according to this invention, in case a servo pattern is formed like before, an erasion field is generated, or bit deflection stops arising and location detection precision improves. In this case, since the servo pattern of the shape of the shape of a straight line and a curve is arranged aslant, it will be in an equivalent condition to the conventional servo pattern magnetically.
[0017] The conventional servo pattern is arranged crosswise [truck] in a pitch predetermined in one truck, and is shifted in the direction of truck length in a pitch predetermined in one truck, and is recorded magnetically. Change of the thickness of a magnetic layer, change of the irregularity of a magnetic layer, and partial use of a magnetic layer constitute the servo pattern of this invention. Even if it impresses the field of fixed magnitude to such two or more servo patterns of structure continuously in the fixed direction from the exterior, servo information is written in each servo pattern. Servo information is acquired by change of a field.
[0018] Moreover, a servo pattern is formed using the pattern of a resist. The pattern of the resist is formed through the exposure process which uses an exposure mask or a laser beam exposure. In forming the latent image of a servo pattern in a resist using an exposure mask, it carries out by rotating the substrate for magnetic-recording media in the shape of a step using one exposure mask. In this case, a resist is partially exposed for every step of rotation of that substrate, and exposure processing will become easy if it carries out by repeating this. Moreover, the alignment or focusing of an exposure mask may be performed whenever it suspends rotation of a substrate.
[0019] moreover, the substrate which is going to form a servo pattern when exposing a resist by the exposure of a laser beam -- a step -- or exposure processing will become quick if it carries out making it rotate continuously. Furthermore, if a servo pattern is formed in a servo field by etching a magnetic layer with laser, an accurate pattern will be obtained, without passing through exposure and the development of a resist.
[0020]
[Embodiment of the Invention] Then, the operation gestalt of this invention is explained based on a drawing below.
(The 1st operation gestalt) Drawing 1 is a magnetic disk (magnetic-recording medium) concerning the operation gestalt of this invention. It is the top view showing the interior of the magnetic disk drive which it has.
[0021] The disc-like magnetic disk 42 is contained in the housing 41 of the magnetic disk drive 40 shown in drawing 1 , and the core is being fixed to the rotation shaft 43 of a spindle motor. The truck 44 of a large number located in a line in the direction of a path from the center of rotation is set to the field of the magnetic-recording layer of a magnetic disk 42, and each truck 44 surrounds the perimeter of the center of rotation and is circular. Moreover, two or more servo fields 45 which extend in the direction of a path from the center of rotation in the field of a magnetic-recording layer are arranged in the hoop direction. In addition, the truck 44 and the servo field 45 which are shown in drawing 1 are what was indicated in order to make an understanding of this invention easy, and do not appear in magnetic-disk 42 front face in fact.
[0022] On such a magnetic disk 42, the slider 46 which attached the magnetic head is supported and arranged at the tip of a head arm 47, and, as for the slider 46, the location on a magnetic disk 42 is changed by the deflection of a head arm 47. The head arm 47 is attached in the rotation shaft 48 of a stepping motor in the part of the central approach, and it is constituted so that it may move with the rotation shaft 48 rotated with the signal from the truck control circuit 49. The truck control circuit 49 recognizes the truck location under the magnetic head according to the phase contrast of the servo pattern for the tracking of the servo field 45.
[0023] Next, the magnetic disk 42 mentioned above is further explained to a detail. In the servo field 45 of a magnetic disk 42, it is drawing 2 (a). The servo pattern 51 of the shape of a straight line which inclined at an angle of predetermined is formed ranging over two or more trucks 44 from the tangential direction of a truck 44, and the servo pattern 51 sets spacing and is formed in the hoop direction two or more so that it may be shown. Width of face W1 of the truck 44 Drawing 2 (b) It has the almost same magnitude as the magnetic pole width of face of the head for record of the magnetic head 50, or the sense width of face of the head for playback so that it may be shown.
[0024] The magnetic disk 42 which has the servo pattern 51 has cross-section structure as shown in drawing 3 . The magnetic disk 42 shown in drawing 3 is a glass wafer, a silicon wafer, or NiP. It has the wrap protective layer for the nonmagnetic substrate 52 which consists of a covered aluminum wafer, the substrate layer 53 which consists of nonmagnetic material, such as Cr on a substrate 52, and SiO2, the magnetic-recording layer 54 which consists of hard magnetic materials, such as CoCrTa on the substrate layer 53, CoCrPt, and CoCr, and the magnetic-recording layer 54. About the thickness of those layers 53-55, the substrate layer 53 is [20nm and the protective layer 55 of 50nm and the magnetic-recording layer 54] 15nm. In addition, in adopting the structure of omitting the substrate layer 53, the field of a substrate 52 turns into a substrate side of the magnetic-recording layer 54.
[0025] The slot 56 which embeds some servo patterns 51 in the substrate layer 53 which exists in the servo field 45 is formed, and hard

magnetic layer 51a, such as CoCrTa, CoCrPt, and CoCr, is embedded in those slots 56. Hard magnetic layer 51a in one slot 56 and the magnetic-recording layer 54 on it constitute one servo pattern 51 substantially. And in the servo field 45, since servo information will be written in the magnetic-recording layer 54 on hard magnetic layer 51a and a slot 56, data other than servo information will be recorded on the magnetic-recording layer 54 in the servo field 45. Hard magnetic layer 51a is formed with the same ingredient as the magnetic material which constitutes the magnetic-recording layer 54, or a different ingredient.

[0026] In addition, when omitting the substrate layer 53, a slot 56 will be formed in a substrate and hard magnetic layer 51a will be embedded into it. Next, how to write in the servo information on the servo pattern 51 is explained. The writing of servo information is drawing 4 (a). It is drawing 4 (b) in using the magnetic head 50 **** so that it may be shown. It carries out by using a permanent magnet 57 so that it may be shown.

[0027] Drawing 4 (a) When writing in servo information by the magnetic head 50 so that it may be shown, a direct-current field is generated from the magnetic head 50, rotating the disc-like magnetic disk 42, and the same circumferencial direction is made to magnetize the magnetic-recording layer 54 the servo pattern 51 and around desired by the direct-current field. On the other hand, drawing 4 (b) The south pole and N pole of a permanent magnet 57 are arranged to a circumferencial direction, a magnetic disk 42 is rotated in the condition, and the same sense is made to magnetize the desired servo pattern 51 so that it may be shown.

[0028] Also in the write-in approach of which servo information, it is the same to magnetize all the servo patterns 51 to the same direction by the circumferencial direction. In case servo information is written in, the magnetic-recording layer 54 of fields other than servo field 45 will be magnetized by coincidence, but since the magnetization direction is changed by the writing of data, especially a problem is not produced. Thus, the written-in servo information is the magneto-resistive effect component (head for playback) of the magnetic head 50, as shown in drawing 5 . It is read by 50a or inductive component 50b, and is the field Hs from the both ends of the servo pattern 51. It is changed into a voltage waveform like drawing 5 .

[0029] In this case, in each truck 44, it is drawing 2 (b). Head 50a for playback shifts the direction of truck length, and crosswise [truck] in a predetermined pitch, respectively so that it may be shown. That is, the servo pattern 51 of the shape of a straight line which crosses to two or more trucks 44 aslant, and is arranged is drawing 15 (a) equivalent. It becomes the case where the number of partitions of the shown servo pattern 30 is made [many] to a limit, and equivalence.

[0030] With the magnetic disk 42 of a phase servo system, since the 1st Group I and 2nd group II of the servo pattern 51 are formed in bilateral symmetry by the circumferencial direction as shown in drawing 6 , the truck control circuit 49 recognizes tracking information by change of the phase (spacing) beta of a servo signal based on those groups I and II. In addition, especially the above-mentioned servo pattern 51 may be a curvilinear configuration to which two or more trucks 44 are crossed, as it is not limited to a straight-line configuration and shown in drawing 7 . This is because the direction made into the shape of a curve may be able to make variation of a yaw angle small when shaking the magnetic head 50 between the inner circumference of a magnetic disk 42, and a periphery.

[0031] The above servo patterns 51 of the shape of a straight line or a curve exist as a gestalt-pattern by change of thickness. Therefore, according to such a servo pattern 51, since the processing which sets spacing one by one and writes in the servo pattern 51 with a sufficient precision by the magnetic head becomes unnecessary, a write time is shortened. Moreover, since the consistency of the servo pattern 51 is determined by only change of thickness, it is not necessary to take into consideration a leak and a record blot of the writing of servo information, and a highly precise servo putter is obtained. [the field in the case] Thereby, location detection precision improves.

[0032] Furthermore, since it is formed the shape of a straight line, and in the shape of a curve and he is trying to cross two or more trucks 44 aslant, the servo pattern 51 is drawing 15 (a). Compared with the case where the flat-surface configuration of the shown servo pattern is adopted, it is hard coming to generate the omission of a pattern, and the yield improves. Next, the formation approach of the servo pattern 51 of the above-mentioned magnetic disk 42 (magnetic-recording medium) is explained.

[0033] Although the process which exposes and develops a resist and forms a resist pattern is included in the formation process of the servo pattern described below, in order to expose a resist, an approach as shown in drawing 8 R> 8 or drawing 9 is adopted. Drawing 8 (a) And drawing 9 (a) The disc-like substrate 52 with which the resist 58 was applied to the front face is attached in the rotation shaft of a step motor 59, and how to expose in this condition is shown.

[0034] Drawing 8 (a) The illuminator 60 and the exposure approach which uses the exposure mask 61 are shown. If an exposure mask is made into a magnetic disk 42 and the magnitude which corresponded by 1 to 1, since the whole aligner will turn large up and alignment will become still more difficult, it is not desirable. On the other hand, the servo pattern 51 which it is going to form in a magnetic disk 42 is arranged in the hoop direction repeatedly. Therefore, the exposure mask 61 which has exposure pattern space 61a of magnitude which can divide a magnetic disk 42 equally to a hoop direction at n (n is the natural number) individual is prepared. and the exposure mask 61 -- the upper part of a substrate 52 -- fixing -- the illuminator 60 on it -- predetermined time t1 only -- after irradiating and imprinting the pattern of the exposure mask 61 to a resist 58, the rotation section of a step motor 59 is rotated only 360/n times, ******** actuation is repeated only n times, is performed, and exposure of the whole surface of a resist 58 is finished. The optical exposure of an illuminator 60 and the drive of a step motor 59 are drawing 8 (b). It is controlled by shown timing by the control section 62.

[0035] In addition, before it may perform them whenever the alignment of the exposure mask 61 and focusing suspend a step motor 59, and they start exposure, they may be performed only once. Moreover, drawing 9 (a) While having a laser light source 63 and the laser scan system mirror 64, being based on data from the pattern data storage section 65 and a control section's 66 making a laser light source 63 turn on and turn off, the laser scan system mirror 64 is shaken and a laser beam is made to scan in the direction of a path of a substrate 52.

[0036] The exposure of a laser beam, ON of a step motor 59, and OFF are drawing 9 (b). After finishing the scan of 1 time of the laser beam of the direction of a path so that it may be shown, only a predetermined step rotates a step motor 59, a control section 65 repeats actuation of making the direction of a path expose further, performs it, and where the rotation section of a step motor 59 is rotated 360 degrees, it finishes exposure processing of the whole surface of a resist 58.

[0037] In addition, it is also possible to perform exposure which used the laser beam for every hoop direction. In this case, drawing 9 (c) While driving a step motor 59 continuously with a predetermined rotational speed so that it may be shown, it will double with a pattern, and a laser beam exposure will be turned on and turned off. How to manufacture the magnetic disk 42 of the cross-section structure shown in drawing 3 using such an exposure approach is explained below.

[0038] First, drawing 10 (a) The substrate layer 53 is formed on a substrate 52, and a resist 58 is further applied on the substrate layer 53 so that it may be shown. Then, it exposes by the exposure approach which showed the resist 58 to drawing 8 or drawing 9 R> 9, and the latent image of a servo pattern is formed. After that, it is drawing 10 (b). Opening 58a is formed in the part in which a resist 58 is developed and the servo pattern 51 should be formed so that it may be shown.

[0039] Next, drawing 10 (c) The substrate layer 53 of the part exposed from opening 58a of a resist 58 is etched, and a slot 56 is formed so that it may be shown. A slot 56 is drawing 10 (c). You may be the depth of extent to which a substrate 52 is not exposed like, and may be the depth in which a substrate 52 is exposed. As an etching method, there are ion milling, sputter etching, chemical etching, etc. Moreover, when using the component of a substrate 52 as silicon, reactive ion etching can be applied.
[0040] Furthermore, drawing 10 (d) If hard magnetic layer 51a is formed in the whole by the spatter, and a slot 56 is filled, then a resist 58 is exfoliated with a solvent so that it may be shown, hard magnetic layer 51a will remain only in a slot 56. After that, flattening of the hard magnetic layer 51a is carried out to the substrate layer 53 using mechanical polish, ion milling, etc. Since flattening of the field where the magnetic head 50 counters is carried out by this flattening, a possibility that the magnetic head 50 which slides on a it top may be destroyed by projection disappears.
[0041] After such flattening processing, it is drawing 10 (e). The magnetic-recording layer 54 is formed on hard magnetic layer 51a and the substrate layer 53 by the spatter at the thickness of 5-100nm, and if a protective coat 55 is formed on it, the magnetic disk of the cross-section structure shown in drawing 3 R> 3 will be further completed, so that it may be shown. In addition, lubricant may be applied on a protective layer 55.
(The 2nd operation gestalt) With the 1st operation gestalt, although the magnetic-recording layer 54 is formed on hard magnetic layer 56a as a servo pattern 51, since it is good even if reverse in the vertical relation of them, the operation gestalt is explained below.
[0042] Drawing 11 is the fragmentary sectional view of the magnetic disk (magnetic-recording medium) concerning the 2nd operation gestalt of this invention. Since it is the same in the 1st operation gestalt having explained, the flat-surface configuration of the pattern of hard magnetic layer 51a and arrangement which constitute the servo pattern 51 are omitted. Setting to drawing 11 , a magnetic disk 42 is a glass wafer, a silicon wafer, or NiP. The nonmagnetic substrate 52 which consists of a covered aluminum wafer, The substrate layer 53 which consists of nonmagnetic material, such as Cr on a substrate 52, and SiO2, The magnetic-recording layer 54 which consists of CoCr on the substrate layer 53, CoCrPt, CoCrTa, CoNiCr, etc., Hard magnetic layer 51a which consists the magnetic-recording layer 54 of CoCr, CoCrPt, CoCrTa, CoNiCr, etc. which were embedded in the middle class 67 in wrap nonmagnetic the middle class 67 and the servo field 45, hard magnetic layer 51a, and the middle class layer 67 consist of wrap protective layers 55.
[0043] In the interlayer 67, the flat-surface configuration of the slot 68 which embeds hard magnetic layer 51a is the same as the flat-surface configuration of the servo pattern 51 explained with the 1st operation gestalt, and hard magnetic layer 51a in it is in contact with the magnetic-recording layer 54 in the lower part of a slot 68. And the servo pattern 51 is constituted by hard magnetic layer 51a in a slot 68, and the magnetic-recording layer [directly under] 54 of it.
[0044] Also in such a servo pattern 51, the write-in approach of servo information is the same as the 1st operation gestalt. Moreover, the servo information written in the servo pattern 51 will be read by the magnetic head 50. Moreover, since the nonmagnetic middle class 67 is embedded in the perimeter of the servo pattern 51, the distance of the servo pattern 51 and the magnetic head 50 serves as the flying height of the magnetic head 50, and magnitude which added the thickness of a protective layer 55. Consequently, the servo field inputted into the magnetic head 50 becomes large, and read-out of tracking information becomes certain.
[0045] It also sets in this operation gestalt and the servo pattern 51 of the shape of the shape of a straight line and a curve is drawing 2 (a). Or like drawing 7 , it is formed in two or more trucks 44 covering the direction of slant, and, moreover, the pattern is formed of change by the circumferencial direction of that thickness. Therefore, according to such a servo pattern 51, a write time is shortened like the 1st operation gestalt, and a highly precise pattern is obtained.
[0046] Furthermore, since the servo pattern 51 is formed the shape of a straight line, and in the shape of a curve and he is trying to cross two or more trucks 44 aslant, a mechanical strength becomes strong rather than the isolated pattern, and the defect of a pattern stops being able to produce it easily. In addition, in this operation gestalt, if shown in drawing 2 , similarly any data other than servo data will not be recorded on the magnetic-recording layer 54 of the servo field 45.
[0047] Next, an example of the formation approach of the servo pattern 51 of the structure shown in drawing 11 is given and explained. First, drawing 12 (a) After forming the substrate layer 53 which consists of Cr on a substrate 52 at the thickness of 50nm so that it may be shown, it forms in the thickness of 20nm and the interlayer 67 who consists of SiO2 further is formed in the thickness of 5-20nm for the magnetic-recording layer 54 which consists of CoCrPt. These layers 53, 54, and 67 are formed by the spatter. Then, a resist 58 is applied on the middle class 67, it exposes according to the exposure direction which showed this to drawing 8 or drawing 9 , and the latent image of a servo pattern is formed in a resist 58.
[0048] Next, a resist 58 is developed and it is drawing 12 (b). Patterning of the resist 58 is carried out so that it may be shown, and opening 58b is formed in the part which forms a servo pattern. After that, it is drawing 12 (c). Etching removes the middle class 67 who is not covered with a resist 58, and a slot 68 is formed so that it may be shown. As the etching method, there are ion milling, sputter etching, chemical etching, etc.
[0049] Next, drawing 12 (d) If a resist 58 is continuously formed hard magnetic layer 51a which consists of CoCrPt by the spatter in the thickness of 5-20nm and exfoliated in the whole with a solvent so that it may be shown, hard magnetic layer 51a will remain only in a slot 68. And flattening of hard magnetic layer 51a and the interlayer 67 is carried out by polish etc. Thereby, the servo pattern 51 is constituted by hard magnetic layer 51a and the magnetic-recording layer [directly under] 54 of it.
[0050] After such a flattening process, it is drawing 12 (e). If a protective coat 55 is formed on hard magnetic layer 51a and the middle class 67 so that it may be shown, the magnetic disk of structure as shown in drawing 11 will be completed. In addition, the substrate layer 53 is omitted in many cases. Moreover, lubricant may be applied on a protective layer 55.
(The 3rd operation gestalt) The servo pattern 51 of the shape of the above-mentioned shape of a straight line and a curve may be formed by carrying out patterning of a part of magnetic-recording layer 54.
[0051] For example, drawing 13 (a) After forming the substrate layer 53 and the magnetic-recording layer 54 with a thickness of about 20nm by the spatter on a substrate 52 so that it may be shown, a resist 58 is applied on the magnetic-recording layer 54. And it exposes by the approach which showed this resist 58 to drawing 8 R> 8 or drawing 9 , subsequently negatives are developed, and patterning of the resist 58 is carried out. As for the resist 58, opening 58c is formed in the perimeter of a servo pattern in the servo field 45 with the wrap except servo field 45.
[0052] Then, while ion milling, sputter etching, chemical etching, etc. remove the magnetic-recording layer 54 which is not covered with a resist 58, and forming slot 54a and leaving magnetic-recording layers 54 other than servo field 45, the magnetic-recording layer 54 which remained in the servo field 51 is used as a servo pattern 51. Subsequently, drawing 13 (b) It is filled up with the slot which generated the magnetic-recording layer 54 and the servo pattern 51 around the servo pattern 51 with the wrap in the protective coat 55 by the protective

coat 55 so that it may be shown. Flattening of the protective coat 55 may be carried out in that case. Furthermore, a magnetic disk will be completed if lubricant 70 is applied on a protective coat 55.

[0053] In addition, when forming the servo pattern 51, the process which carries out patterning of the magnetic-recording layer (hard magnetic layer) 54, and acquires the configuration of a servo pattern may be adopted by irradiating the laser beam of high energy. the exposure condition and timing of the laser beam -- drawing 9 (a) - drawing 9 (c) It is the same if shown. Drawing 13 (b) Although the shown servo pattern 51 carries out patterning of the magnetic-recording layer 54 of the servo field 45 and is formed, it explains how to form the servo pattern 51 below, without carrying out patterning of the magnetic-recording layer 54.

[0054] First, drawing 14 (a) The wrap resist 58 is formed for the fields and servo pattern formation parts other than servo field 45 of a substrate 52 so that it may be shown. That is, the resist 58 which has 58d of apertures is formed in the perimeter of a servo pattern formation part in the servo field 45. Formation of 58d of apertures of the resist 58 is formed through the exposure processing shown in drawing 8 or drawing 9 . Then, a resist 58 is used as a mask, a substrate 52 is etched into a depth of 20nm, and a slot 72 is formed in a substrate 52. By this, the hard magnetism material 71 deposited in the slot 72 in the servo field 45 will keep away from the magnetic head 50. Next, after exfoliating a resist 58 with a solvent, it is drawing 14 (b). The hard magnetism material 71 is formed in the thickness of 20nm by the spatter so that it may be shown, and subsequently it is drawing 14 R> 4 (c). A protective coat 55 is formed on the hard magnetism material 71, and lubricant 70 is further applied on it so that it may be shown.

[0055] Drawing 14 (c) With the shown magnetic disk, it is drawing 4 (a). Or drawing 4 (b) When a strong external magnetic field is impressed to the hard magnetism material 71 by the shown approach, compared with other fields, it will be magnetized weakly, and, moreover, the hard magnetism material 71 in the slot 72 where distance is distant will keep away from the magnetic head 50 for playback. Consequently, the field which comes out from this slot 72 becomes very small. Consequently, in the servo field 45, the inserted heights which were surrounded by the slot 72 of the hard magnetism material 71 function as a servo pattern 51. Moreover, the hard magnetic layer 71 of fields other than servo field 45 functions as a magnetic-recording layer 54.

[0056] Drawing 13 (b) Drawing 14 (c) The change and the servo detecting signal of a field by the servo pattern 51 in the servo field 45 of a magnetic disk become the same substantially with drawing 5 . In addition, drawing 13 (b) Drawing 14 (c) Like the 1st and 2nd operation gestalt, the flat surface of the shown servo pattern 51 has the configuration of the shape of a straight line or a curve, and is drawing 2 (a). Or similarly, if shown in drawing 7 , it is arranged so that two or more trucks 44 may be crossed aslant.

[0057]

[Effect of the Invention] Since the servo pattern of the shape of the shape of a straight line which crosses two or more trucks aslant, and a curve was formed in the magnetic-recording medium in the physical configuration according to this invention as stated above, an erasion field can be generated to a servo pattern like before, or it becomes impossible for ** to arise and a bit knee can improve location detection precision.

[0058] Since change of the thickness of a magnetic layer, change of the irregularity of a magnetic layer, and partial use of a magnetic layer constitute the servo pattern of this invention, it can impress the field of fixed magnitude continuously in the fixed direction from the exterior, and can write in servo information at high speed. Moreover, the resist used for patterning of a servo pattern rotates the substrate for magnetic-recording media in the shape of a step using one exposure mask, a resist is partially exposed for every step of rotation of the substrate, and exposure processing will become easy if it carries out by repeating this.

[0059] moreover, the substrate which is going to form a servo pattern when exposing a resist by the exposure of a laser beam -- a step -- or exposure processing can be made quick if it carries out making it rotate continuously. Furthermore, if a servo pattern is formed in a servo field by etching a magnetic layer with laser, an accurate pattern will be obtained, without passing through exposure and the development of a resist.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

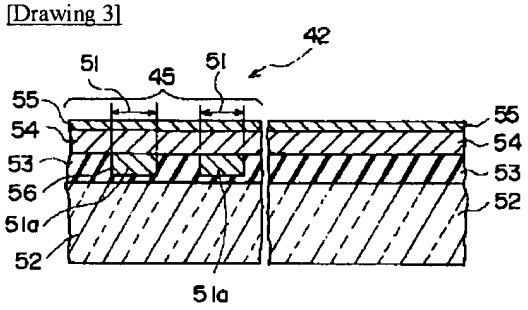
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing 1 is the top view showing an example of a magnetic disk drive which has a magnetic disk concerning the operation gestalt of this invention.
[Drawing 2] Drawing 2 (a) The top view and drawing 2 (b) which show an example of the servo pattern of the magnetic disk concerning the operation gestalt of this invention It is the partial expansion top view.
[Drawing 3] Drawing 3 is the sectional view showing the 1st example of the structure of the magnetic disk concerning the operation gestalt of this invention.
[Drawing 4] Drawing 4 (a) The perspective view and drawing 4 (b) which show the example which wrote in the servo information on the magnetic disk concerning the operation gestalt of this invention by the magnetic head It is the perspective view showing the example which wrote in the servo information on the magnetic disk concerning the operation gestalt of this invention with the permanent magnet.
[Drawing 5] Drawing 5 is the sectional view showing the read-out condition of the servo information on the magnetic disk concerning the operation gestalt of this invention, and the output wave form chart of the magnetic head.
[Drawing 6] Drawing 6 is the top view of a servo pattern and the output wave form chart of the magnetic head explaining the phase servo of the magnetic disk concerning the operation gestalt of this invention.
[Drawing 7] Drawing 7 is the top view showing other examples of the servo pattern of the magnetic disk concerning the operation gestalt of this invention.
[Drawing 8] Drawing 8 (a) is the perspective view and drawing 8 (b) which show the 1st example of the exposure approach of the resist at the time of forming the servo pattern of the magnetic disk concerning the operation gestalt of this invention. It is the timing chart of exposure and a step motor drive.
[Drawing 9] Drawing 9 (a) The perspective view showing the 2nd example of the exposure approach of the resist at the time of forming the servo pattern of the magnetic disk concerning the operation gestalt of this invention, drawing 9 (b), and (c) It is the timing chart of a laser beam exposure and a step motor drive.
[Drawing 10] Drawing 10 (a) - (e) It is the sectional view showing the 1st production process of the magnetic disk concerning the operation gestalt of this invention.
[Drawing 11] Drawing 11 is the sectional view showing the 2nd example of the structure of the magnetic disk concerning the operation gestalt of this invention.
[Drawing 12] Drawing 12 (a) - (e) It is the sectional view showing the 2nd production process of the magnetic disk concerning the operation gestalt of this invention.
[Drawing 13] Drawing 13 (a) and (b) It is the sectional view showing the production process of the 3rd example of the structure of the magnetic disk which this invention requires.
[Drawing 14] Drawing 14 (a) - (c) It is the sectional view showing the production process of the 4th example of the structure of the magnetic disk which this invention requires.
[Drawing 15] Drawing 15 (a) The top view and drawing 15 (b) which show the conventional ideal servo pattern written in one by one by the magnetic head It is the top view showing the condition that the servo pattern was actually written in.
[Description of Notations]
42 Magnetic Disk
44 Truck
45 Servo Field
50 Magnetic Head
51 Servo Pattern
51a Hard magnetic layer
52 Substrate
53 Substrate
54 Magnetic-Recording Layer
55 Protective Layer
56 Slot
57 Permanent Magnet
58 Resist
60 Illuminator
61 Exposure Mask
63 Laser Light Source
64 Laser Scan System Mirror
67 Interlayer

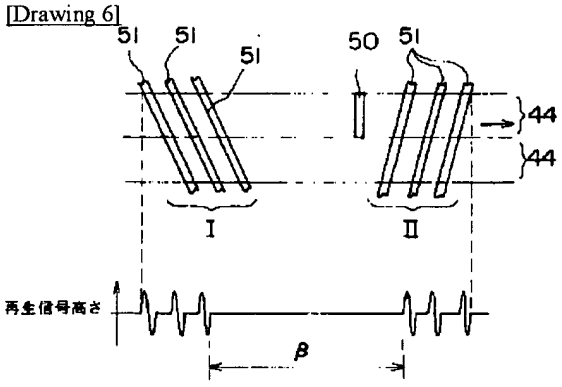
[Translation done.]

DRAWINGS

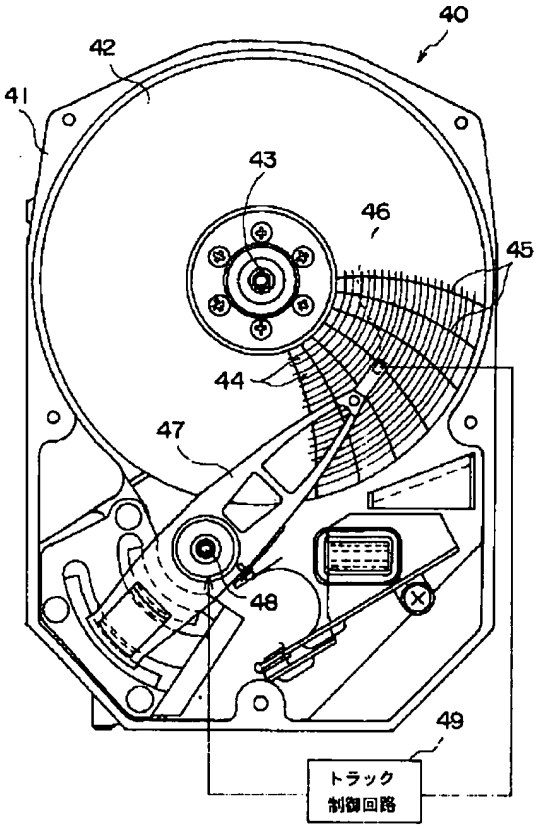
[Drawing 3]



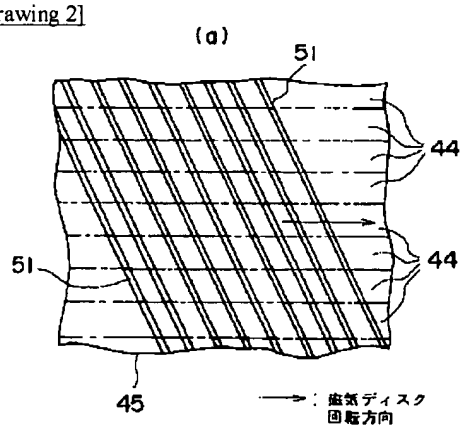
[Drawing 6]

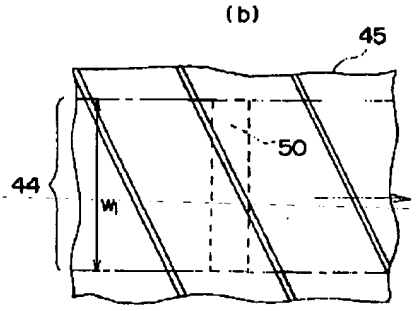


[Drawing 1]



[Drawing 2]





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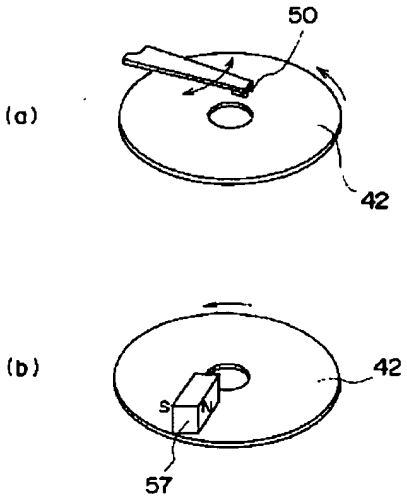
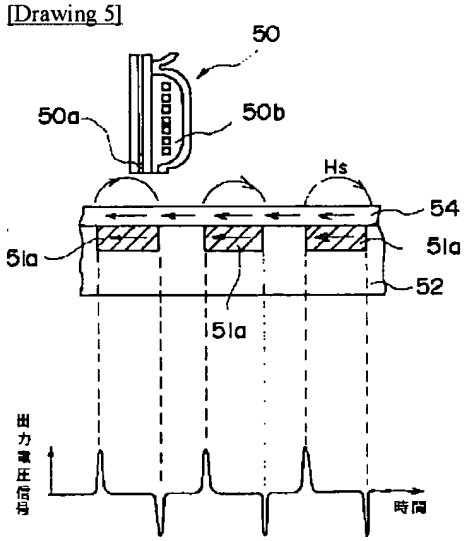


[Drawing 5]



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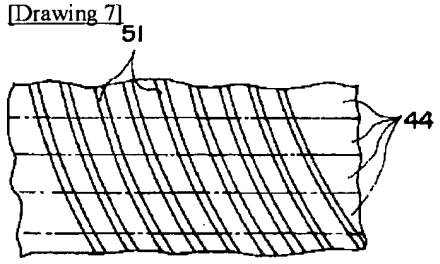

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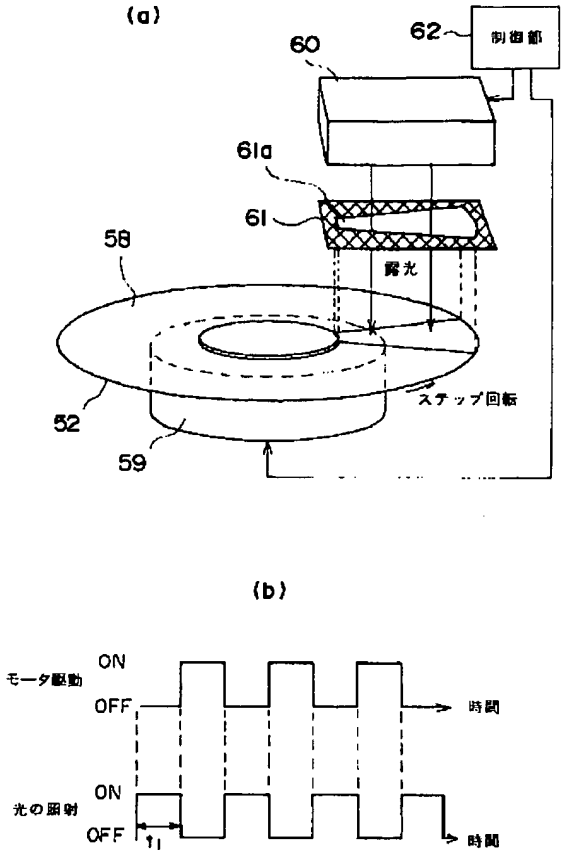
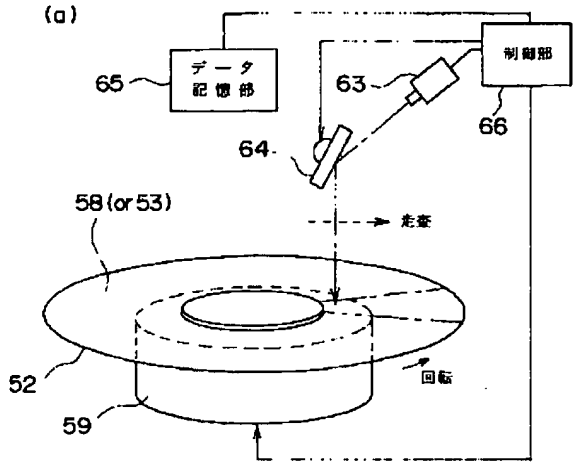
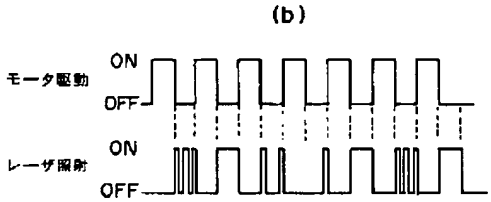
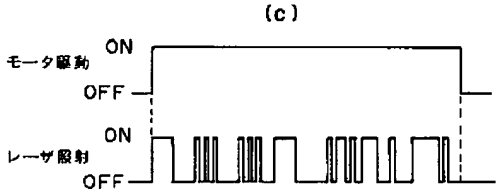

(a)
62
制御部
60
61a
61
58
露光
ステップ回転
52
59
(b)
モータ駆動
ON
OFF
時間
光の照射
ON
OFF
t1
時間

[Drawing 9]







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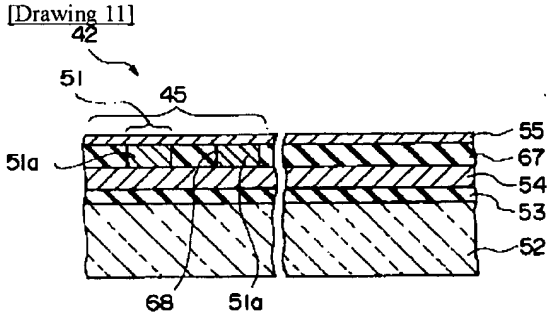
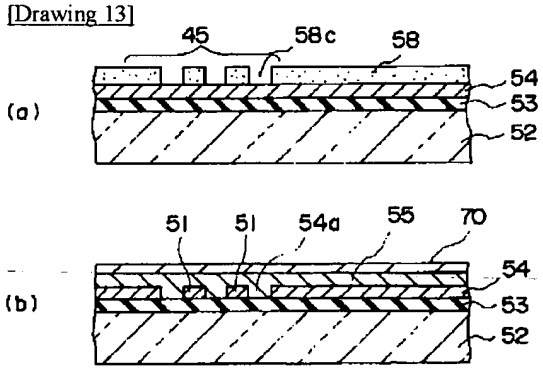


[Drawing 13]



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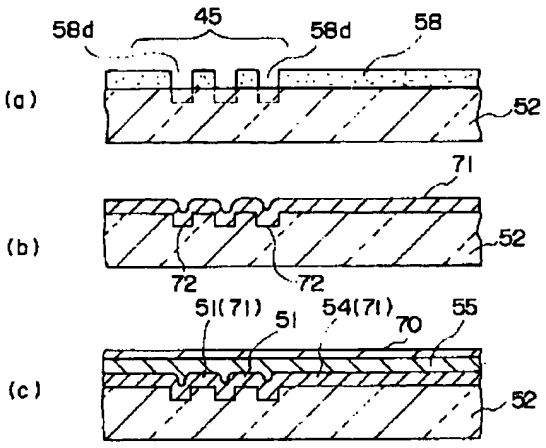
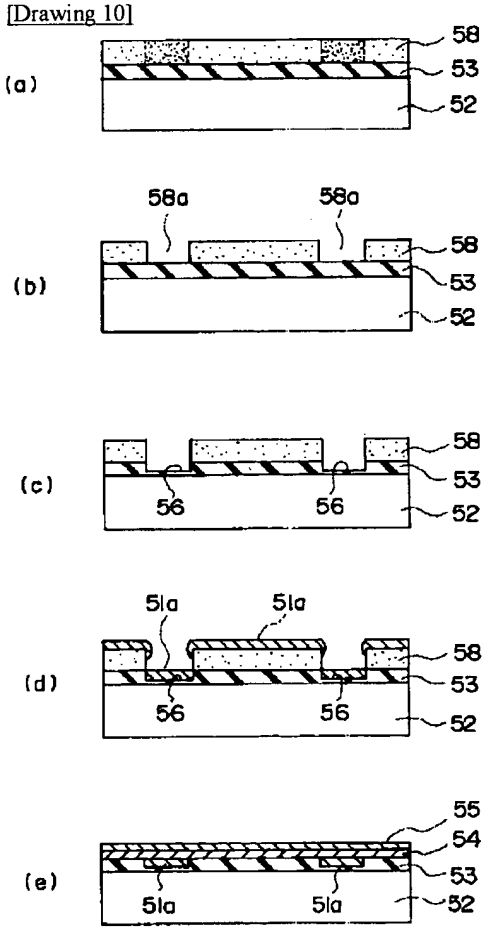
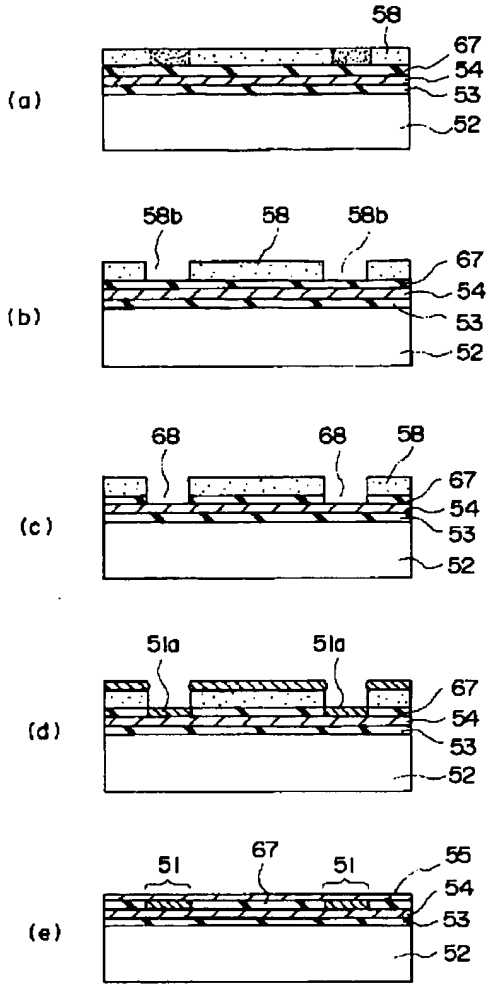


[Drawing 10]



[Drawing 12]


(a)
58
67
54
53
52
(b)
58b
58
58b
67
54
53
52
(c)
68
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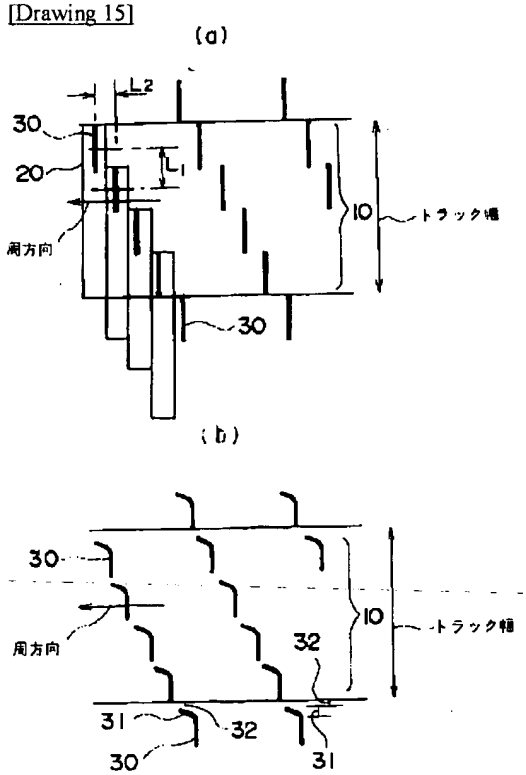
58
67
54
53
52
(d)
51a
51a
67
54
53
52
(e)
51
67
51
55
54
53
52

[Drawing 15]


(a)
L2
30
20
L1
10
トラック幅
周方向
30
(b)
30
周方向
10
トラック幅
32
31
32
30
31

[Translation done.]